OXYGEN SATURATION AS A PREDICTOR OF ADVERSE MATERNAL OUTCOMES IN WOMEN WITH PREECLAMPSIA

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ABSTRACT

Introduction

In preeclampsia, hypoxemia may result from a number of mechanisms. Preeclampsia remains a complex and poorly understood disease. Currently, there are no reliable predictor of preeclampsia for early diagnosis to avoid adverse maternal or perinatal outcomes.

Objective

The objective was to evaluate the efficacy of oxygen saturation (SpO_2) as a predictor of adverse maternal outcome in women with preeclampsia.

Methodology

We conducted the cross-sectional study on 182 preeclamptic women selected by random sampling technique. They were divided into two groups on the basis of oxygen saturation : 29 preeclamptic women (Group L) having oxygen saturation 95% or below and 153 women (Group H) having oxygen saturation 96% or above. The groups were statistically compared with respect to age, gestational age, proteinuria, severity of hypertension and developing different adverse effect of preeclampsia. Women with any medical disorders were excluded

Results

After statistical analysis, it was seen that the women having $Spo_2 \leq 95\%$ (L-Group) had experienced more adverse outcomes. They were more hypertensive and more proteinuric, had higher liver enzyme levels, lower platelet counts, and were more likely to have experienced cardio-respiratory symptoms. Women with adverse outcomes were also more likely to have had therapeutic interventions, including corticosteroids, antihypertensives, and magnesium sulphate.

Conclusion

Women having $SpO_2 \leq 95\%$ (L-Group) had more adverse outcomes in comparison to $SpO_2 \geq 96\%$(H-Group).

KEYWORDS

Pre-eclampsia, oxygen saturation, predictors

INTRODUCTION

Preeclampsia is a multi-organ syndrome that may be characterized by multiple symptoms, signs, and laboratory assessments. It is generally defined as the presence of hypertension (blood pressure ≥ 140/90 mmHg), proteinuria and may be associated with hyperuricemia, haemolysis, abnormal liver function test, and low platelet count. Preeclampsia remains the second leading global cause of maternal mortality.[1] These deaths mainly result from eclampsia, uncontrolled hypertension or systemic inflammation. Pre-eclampsia and eclampsia are still among the most important causes of maternal mortality, both in high and low-income countries.[2,3] The combined adverse maternal outcome is defined as the presence of one or more of the following morbidities: hepatic dysfunction, CNS dysfunction, renal dysfunction, cardiopulmonary dysfunction, haematological dysfunction or maternal death [5,8, 10,11].

Predictors of adverse maternal outcome included gestational age of onset of preeclampsia, chest pain or dyspnoea, oxygen saturation, platelet count, creatinine and aspartate transaminase concentrations. Measurement of oxygen saturation (SpO_2) by pulse oximetry has been widely used in different clinical situations. Preeclampsia is linked with serious maternal comorbidities, including pulmonary oedema and acute respiratory distress syndrome.[4,5] Both of these complications may result in decreased blood gas exchange across the alveoli, with consequent hypoxemia. While maternal blood gas testing is important for the diagnosis of hypoxemia, it is expensive, invasive, painful, and slow, whereas SpO_2 is non-invasive, immediately available in rural and low-resource community settings. Respiratory rate, which is the other bedside method for evaluating possible respiratory distress, is poorly assessed and recorded[6] and has many confounding factors. Therefore, SpO_2 may be a method for a screening tool in this patients.[7,12] The aim of this study was to evaluate the predictive value of SpO_2 in pregnant women admitted to hospital with preeclampsia and to establish risk levels that are more clinically informative.

METHODOLOGY

It was a cross-sectional study performed in the obstetric ward and labour room of the Department of Obstetrics and Gynecology, North Bengal Medical College and Hospital after getting clearance from the institutional ethics committee, North Bengal Medical College from June 2012 to May 2013. Singleton pregnancy, more than 28 weeks of gestation, aged 19-35 years with preeclampsia (blood pressure ≥ 140/90 mmHg and either proteinuria) or superimposed preeclampsia (defined as sudden increase in proteinuria or blood pressure or platelet count < 1,00,000 mm^3 in women with hypertension and proteinuria before 20 weeks' gestation) were included for the study. Exclusion criteria were patient's refusal, chronic hypertension in pregnancy without any features of preeclampsia, mother admitted in active labour with any component of the combined adverse maternal outcome prior to data collection of predictors, multiple pregnancy, intrauterine fetal death and mother with pre-existing other medical complications such as heart diseases, renal diseases, infectious diseases etc. A total of 182 subjects were included with power of 0.9/90% at 5% significance level to detect a difference of 5% in adverse outcome assuming a proportion of adverse effect of 13.1%.

Maternal history was taken regarding the demographic features like, age, gravida, gestational age, and past history of hypertension. Patients were asked for presence of any risk factors like history of hypertension, diabetes mellitus, heart disease, renal disease etc Preeclamptic women of Group L were having SpO_2 of less than or equal to 95% & Group H having SpO_2 of 96% or more. After completion of the study, recorded data were unfolded, tabulated and analyzed statistically. Discrete categorical data are presented as n (%) and median; Continuous data are given as mean SD. The demographic data was tested by Independent-samples t test (continuous data) or by Pearson Chi-square test, Fisher's exact test as appropriate (categorical data) and Mann-Whitney test. For descriptive purposes, p value <0.05 was considered statistically significant. All analysis was conducted using Epi-Info and SPSS for Windows (version 12).[11]

Eligible patients were included in the study considering both inclusion and exclusion criteria with informed consent. After history taking and clinical examinations, oxygen saturation assessment by pulse oximetry was performed at admission for 3 minutes (average value) and then every day for monitoring Data was retrieved daily from the day of admission to the day of delivery and day-1 of puerperium. The value for oxygen saturation used in this study was the lowest SpO_2 value recorded in each patient's medical record within 48 hours after fulfilling the eligibility criteria or before the occurrence of an adverse outcome, which ever occurred first. The information collected from the study was tabulated and analyzed in details. The results were analysed

RESULT

Table 1: Distribution of pregnant mothers Parameter.

	*Group L (n = 29)	*Group H (n = 153)	p value
Age (years)	24.13 ± 0.95	25.60± 0.28	0.060(NS)
Gestational age in weeks	37.65±0.37	37.83±0.13	0.610(NS)
Systolic blood pressure(mm of Hg)	177.51± 4.22	155.76±0.84	0.0001(S)
Diastolic blood pressure(mm of Hg)	114.75±3.27	100.16±0.63	0.0003(S)
Mean arterial blood pressure (mm of Hg)	136.01±3.52	118.44±0.70	0.0001(S)
Prophylactic $MgSO_4$ therapy needed	22(75.86%)	12(7.84%)	0.001(S)

*Total 182 preeclamptic women were enrolled in the study applying the inclusion and exclusion criteria and were allocated into two groups, (Group L and Group H).

Test done: Mann-Whitney test. A value of p<0.05 are considered as significant.

The mean age was 24.13 ± 0.95 years in group L and 25.60 ± 0.28 years in group H. It was evident that there was no statistically significant difference between two groups (p=0.060). The mean Gestational age in weeks was 37.65±0.37 in group L while group H had a mean Gestational age in weeks of 37.83 ± 0.13. Group L and group H were comparable as per distribution of weight which was statistically not significant (p=0.61). The mean systolic blood pressure was 177.51 ± 4.22 mm of Hg in group L and 155.76 ± 0.84 in group H. It was evident that there was statistically significant difference between two groups (p<0.05). The mean diastolic blood pressure was 114.75±3.27 in group L while group H had a mean diastolic blood pressure of 100.16±0.63. Group L and group H were comparable as per distribution (p=0.0003) which was also significant. The mean

arterial pressure was 136.01 ± 3.52 mm of Hg in group L and 118.44 ± 0.70 in group H & this was also statistically significant difference between these two groups (p<0.05).It was also seen that Group L,(SpO_2 is less than or equal to 95%) maximum number of cases22 (75.86%) received prophylactic $Mgso_4$ & least number of cases 7 (24.14%) not needed prophylactic $Mgso_4$ and In Group H (SpO_2 is more than 95%) least number of cases 12 (7.84%) received prophylactic $Mgso_4$ & maximum number of cases 141 (92.16%) not needed prophylactic $Mgso_4$. This is also significant (p =0.001).

Table 2: Distribution of pregnant mothers according to types of pre-eclampsia in Group L(n=29) and Group H. (n= 153)

Parameter	Group L (n = 29)	Group H (n = 153)	p value
Mild pre-eclampsia	10(34.48%)	142(92.81%)	0.0001
Severe pre-eclampsia	16(55.17%)	8(5.22%)	0.001
Superimposed pre-eclampsia	3(10.35%)	3(1.96%)	0.0524

Test done: Fisher's exact test. A value of p<0.05 are considered as significant.

The maximum numbers of cases 83.51% were of mild preeclampsia of which 142(92.81%) were having SpO_2 more than 95% (in group H) and the rest 10(7.19%) were in the group L which was stastically significant (p=0.0001). There were 24 cases of severe preeclampsia in which 16 were in group L (SpO_2 less than 95%) & 8 were in group H which was also stastically significant (p=0.001). In superimposed PE group there were only 6 cases of which were equally distributed in each group (L&H) which was not-significantstastically (p=0.0524).

Table 3: Distribution of pregnant mothers according to types of pre-eclampsia in Group L(n=29) and Group H. (n= 153)

Parameter	Group L (n = 29)	Group H (n = 153)	p value
Chest pain/Dyspnoea	4(13.79%)	0	0.0005
Transfusion of blood products	1(3.44%)	0	0.1593
Abnormal renal function tests	1(3.44%)	0	0.0524
Abnormal liver functiontests	2 (6.89%)	1(0.65%)	0.060
Pulmonary oedema	2 (6.89%)	0	0.1593
Heart failure	1(3.44%)	0	0.0524
Development of eclampsia	1(3.44%)	1(0.65%)	0.2940
Glasgow coma scale<13	1(3.44%)	0	
Cerebrovascular accidents	0	0	
Retinal detachment	0	0	
Placental abruption	1(3.44%)	1(0.65%)	0.2940(NS)
Maternal death	1(3.44%)	0	0.1593(NS)

*Few women in both groups developed multiple complications simultaneously.

Table 3 shows the different adverse outcomes of pre-eclampsia (mild, severe and superimposed) in Group L and Group H. It shows that chest pain/dyspnoea (13.79% in Group L vs. 0% in Group H) only this adverse outcome was statistically significant (p<0.05).

On the other hand transfusion of blood product (3.44% in Group L vs. 0% in Group H), abnormal R.F.T (3.44% in Group L vs. 0% in Group H), abnormal L.F.T (6.89% in Group L vs. 0.65% in Group H), pulmonary oedema (6.89% in Group L vs. 0% in Group H), heart failure (3.44% in Group L vs. 0% in Group H), eclampsia (3.44% in Group L vs. 0.65% in Group H), GCS<13 (3.44% in Group L vs. 0% in Group H) eclampsia (3.44% in Group L vs. 0.65% in Group H), placental abruption (3.44% in Group L vs. 0.65% in Group H). These adverse effects were statistically non-significant (p<0.05). There was one maternal death in Group L (3.44%) and the cause of death was pulmonary oedema, heart failure in severe pre-eclamptic women having HELLP syndrome. This effect was statistically not significant (p>0.05).Where as retinal detachment & cerebrovascular accident (CVA) did not develop in either groups.

DISCUSSION

In our study total 182 mothers diagnosed as pre-eclamptic were enrolled after admission in the obstetric ward or labour room of the Department of Obstetrics and Gynecology, North Bengal Medical College and Hospital. All patients were divided into two groups on the basis of oxygen saturation: 29 pre-eclamptic women (Group L) having oxygen saturation 95% or below and 153 women (Group H) having oxygen saturation 96% or above. In our study, maternal adverse outcomes were mainly seen in the L-group

Alexandra L. Millman et. al classified pre-eclamptic women into various groups on the basis of oxygen saturation. Baseline (98% to 100%), low risk (96% to 97%), medium risk (94% to 95%), and high risk (90% to 93%). They successfully predicted SpO_2 as an adverse maternal outcomes and found SpO_2 value of ≤93% conferred particular risk. The study also revealed that SpO_2 of 90% to 93% was independently associated with an 18-fold increase in the odds of an adverse outcome within 48 hours compared with a normal SpO_2 (98% to 100%).

In our study the mean and median maternal age was 24.13 ± 0.95 age and 23years in group L while 25.60 ± 0.28 years and 26years in group H. Here p value is 0.060, statistically insignificant. So, there was no difference in mean maternal age between group L and H. Similarly there was no difference in median maternal age in a study done by Alexandra L. Millman et.al.[9] in which median maternal age was 31yrs in patients developing adverse outcome and median maternal age was 32 yrs in patients having normal outcome where the *p* value was 0.523 which was statistically insignificant.

The mean and median Gestational age was 37.65±0.37 weeks, 38 weeks in group L while 37.83 ± 0.13 weeks and 38 weeks in group H which was also statistically not significant (p=0.61). This finding contradict the result obtained from a study done by Alexandra L. Millman et al ,where median gestational age was 34.1 weeks in patients developing adverse outcome and median gestational age was 36.3 weeks in patients having normal outcome which was statistically significant(*p*< 0.001).

According to Peter von Dadelszen et. al gestational age at the time of admission to hospital for pre-eclampsia was found significantly lower and independently predictive, in women destined to develop complications[8]. Disease onset at less than 32 weeks gestation was found to be associated with a 20-times increased risk of maternal mortality.

In our study proteinuria++ (mild to moderate) were seen in 41.37% and 90.19% women in Group L and Group H respectively. The incidence of proteinuria++ (mild to moderate) was significantly higher in H group than in L group (p<0.050). Also, Proteinuria+++ (severe) were seen in 31.03% and 9.15% women in Group L and Group H respectively. Proteinuria++++ (severe) were seen in 27.58% and 1%

women in Group L and Group H respectively. The incidence of severe proteinuria i.e +++ and ++++ was significantly more in group L than in group H (p<0.050).

Alexandra L. Millman et.al similarly found that the median proteinuria was +++ in patients developing adverse outcomes whereas median proteinuria was ++ in patients having normal outcome which was found to be statistically significant (*p*< 0.001).Peter von Dadelszen also revealed dipstick proteinuria to be higher in women who developed adverse outcomes [8].

In our study the mean and median of systolic blood pressure was 177.51 ± 4.22 mm of Hg and 170 mm of Hg in group L while 155.76 ± 0.84 and 156 in group H respectively which was statistically significant (p<0.05). The mean and median of diastolic blood pressure was 114.75±3.27 and 120 mm of Hg in group L while 100.16 ± 0.63 and 98 mm of Hg in group H respectively which was statistically significant (p<0.05). The mean and median of mean arterial pressure was 136.01 ± 3.52 and 136.67 mm of Hg in group L and 118.44 ± 0.70 and 117.30 mm of Hg in group H which was also statistically significant(p<0.05).

Alexandra L. Millman et.al similarly found that the median systolic blood pressure was 170 mm of Hg in adverse outcome group and 162 mm of Hg in normal outcome group which was statistically significant (p<0.05) .The median diastolic blood pressure was 105 mm of Hg in adverse outcomes while 102 mm of Hg in normal outcome group which was also found statistically significant. The median of mean arterial pressure was 125 mm of Hg in adverse outcomes group and 121mm of Hg in normal outcomes group which was statistically significant.

In our study (13.79%) 4 patients developed chest pain/ dyspnoea in L group whereas none of the patients developed chest pain among H group which was the only statistically significant (p<0.05) adverse outcome. One patient (3.44%) each developed adverse outcome like abnormal RFT, heart failure and GCS<13 in the L group (Spo_2 ≤95%) of the study whereas none of the patients among H group developing the same. Regarding transfusion of blood products only one (3.44%) patient among L group & none among H group developed the same. Abnormal LFT were seen in two patients (6.89%) among L group and one (0.65%) among H group. Eclampsia developed in one patient (3.44%) among L group and one (0.65%) among H group. Pulmonary oedema developed in two patients (6.89%) among L group and none among H group. Placental abruption were seen in One patient (3.44%) among L group and one patient (0.65%) among H group. Maternal death seen in only one patient in L group. All these adverse outcomes were statistically nonsignificant (p>0.05). None of the patients of either group developed cerebral-vascular accident and retinal detachment.

According to the PIERS developed through international Delphi consensus in year 2011, Women with adverse outcomes were sicker overall; they were more hypertensive, more proteinuric, had higher liver enzyme levels, lower platelet counts, and lower SpO_2 levels, and have experienced more cardio respiratory symptoms. Women with adverse outcomes required more therapeutic interventions, including corticosteroids, antihypertensives, and magnesium sulphate.

CONCLUSION

This cross sectional observation study concludes that there was no statistically significant variation in distribution of preeclamptic women regarding maternal age and gestational age between group L and H. The systolic, diastolic blood pressure was more in group L .The mean arterial pressure was also more in group L and these were statistically significant. Women having SpO_2 ≤ 95% (L-Group) were sicker overall and experienced more adverse outcomes in comparison to SpO_2 ≥96%(H-Group).

LIMITATIONS OF THE STUDY

More sample size may be needed for betterment.

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RECOMMENDATIONS

We recommend measurement of SpO_2 of all pregnant mothers with pre-eclampsia during admission to detect the mothers with low SpO_2<95% as they are more prone to develop adverse outcome. They will need great care and monitoring to avert from life threatening complications.

CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

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